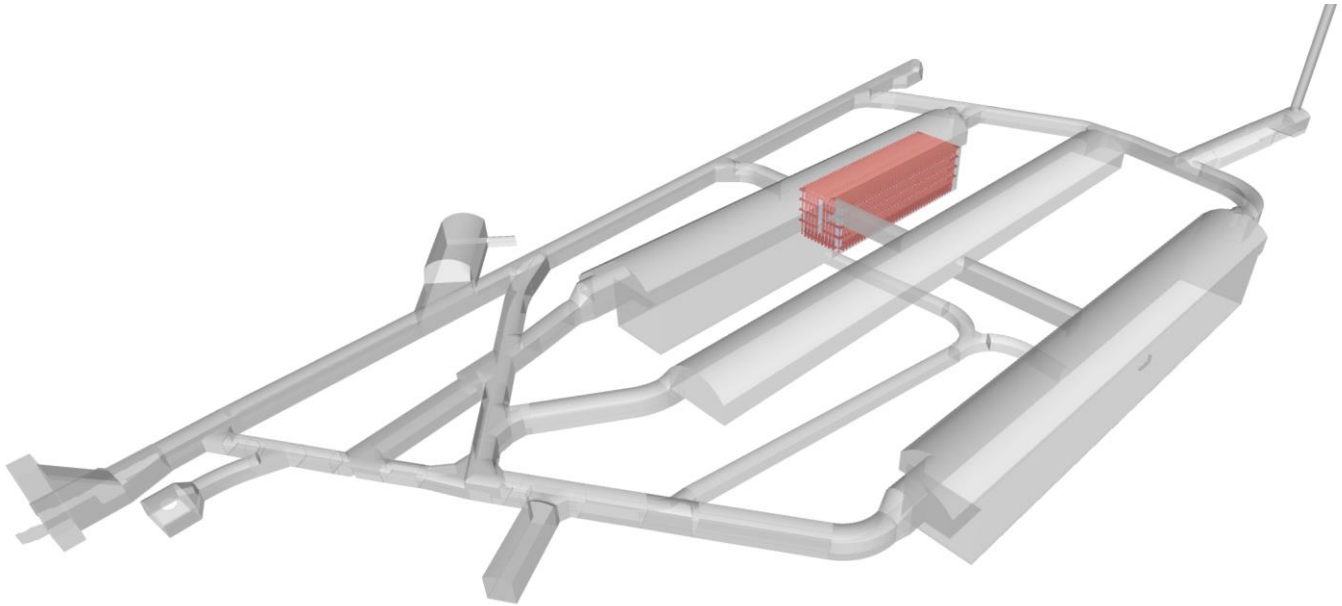
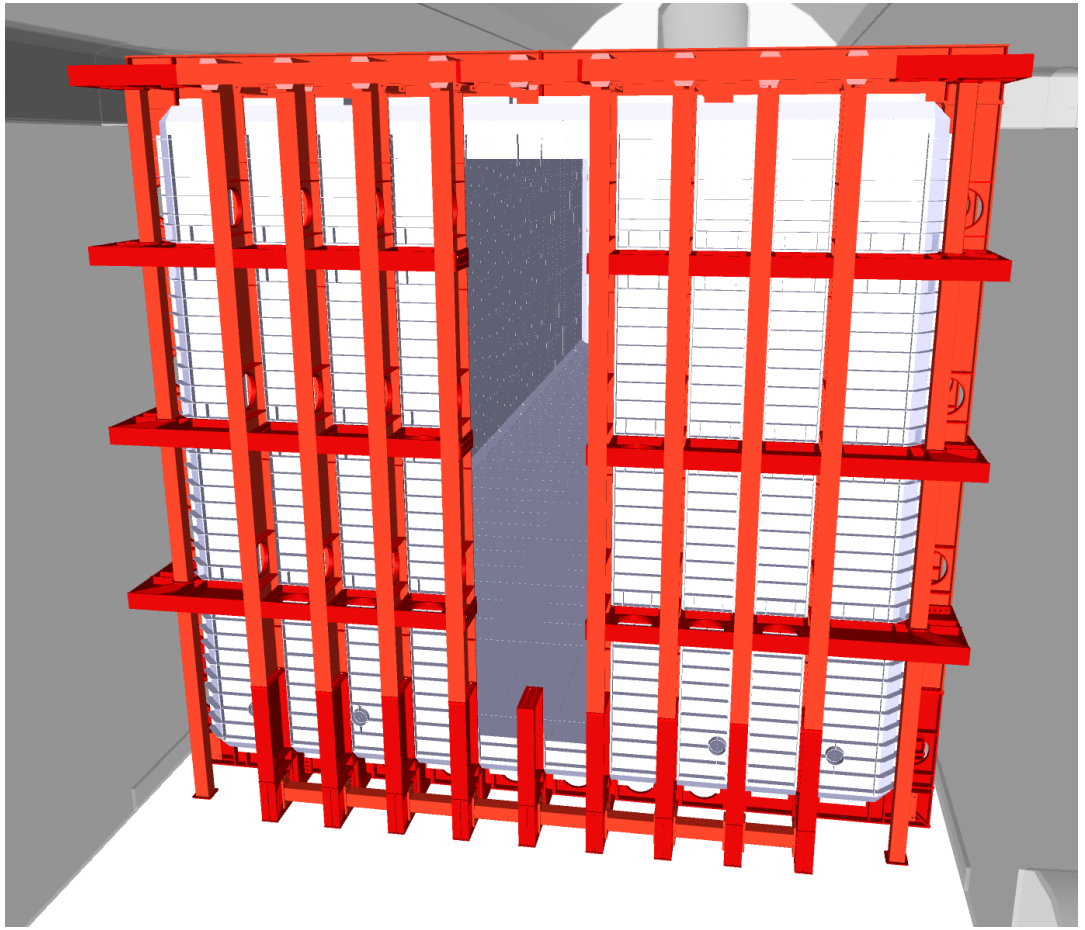
# Handover requirements FS

J Fowler

# Cryostat warm structure





# Assumptions to begin warm structure

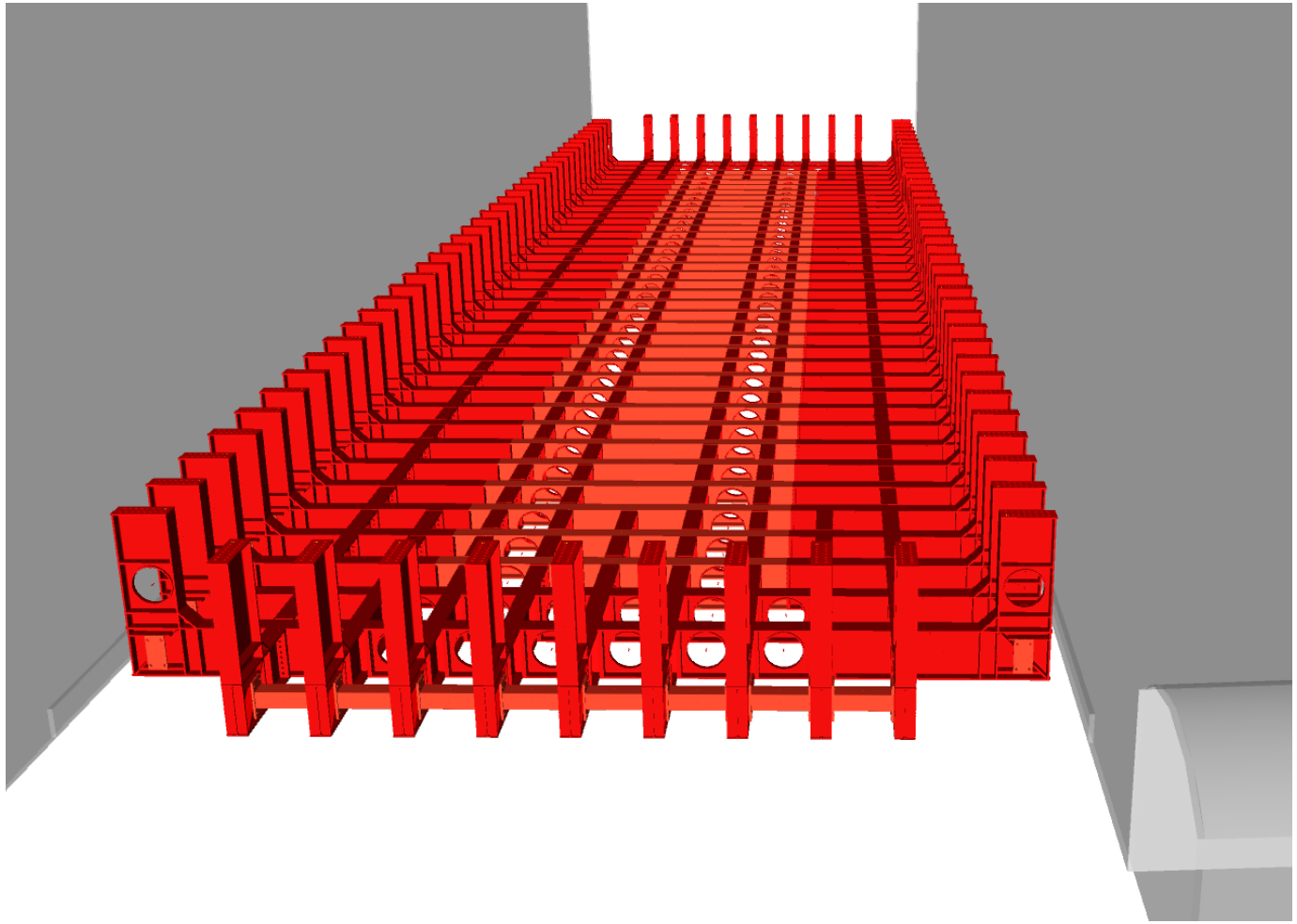
- Can be constructed with temporary services, including lighting, ventilation, and power
- Cryostat construction can occur within the established underground personnel limits
- Cryostat construction start will require the complete construction/installation of the floor slab and overhead crane and monorail hoists (controls, power and commissioning) in the North cavern
- Two means of egress are available down to the 4910 level for cryostat construction to begin
- Similar ES&H program to current construction for cryostat contractor

# General items required to begin construction

- Establish egress paths to 4910 level
  - FSCF stairs, temporary stairs and Alimak at W end of cavern
  - Safety railings at 4850 as needed at all entrances to the N cavern
- Temporary lighting at 4910 and at E and W entrances of cavern
- Confirm crane, monorails and hoist operation
- Confirm adequate ventilation for occupation
- AC power delivered to E and W entrances at 4850 and to alcove mid cavern at 4910
- Logistics chain from Surface to 4910
- Compressed air

# Construction activities for cryostat floor

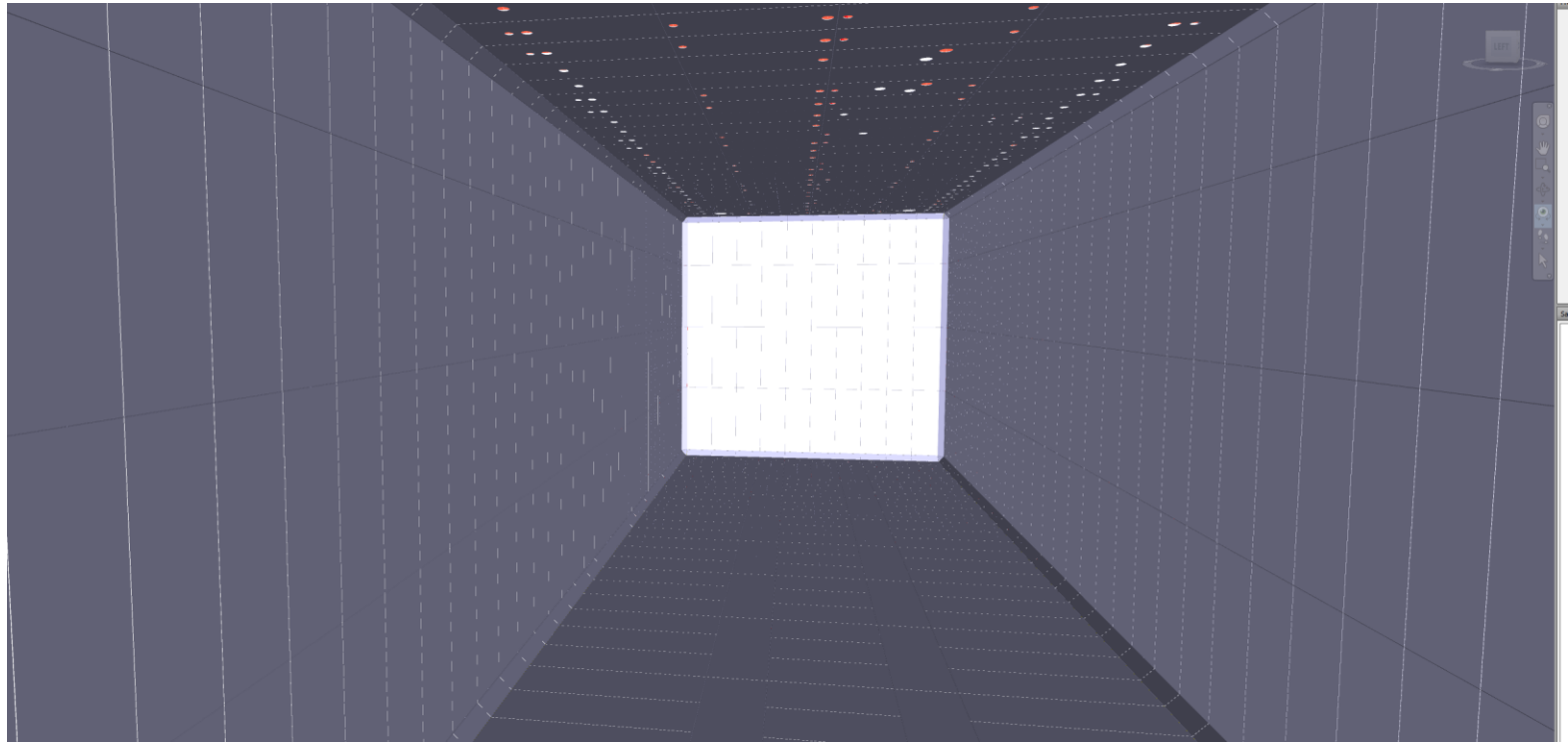
- Cryostat construction will be a contracted effort with a steel erection firm with oversight by the design team
- Crane and hoists for material movement and positioning
- Compressed air for pneumatic bolting tools
- General lighting and task lighting
- Ventilation for occupation



# Cryostat roof

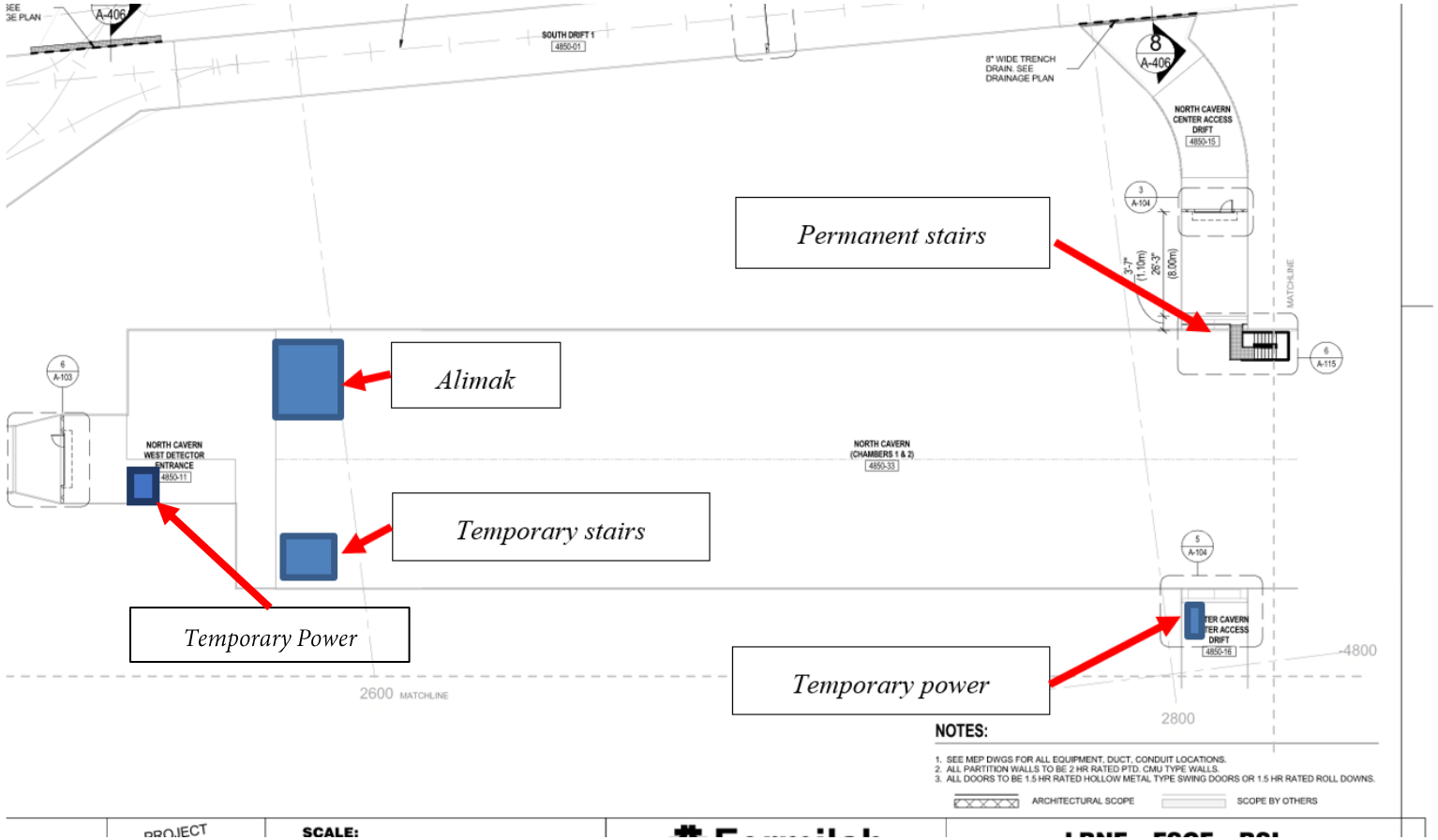
# Tertiary membrane inside the structure

- Tertiary membrane is ~1cm thick steel plate with structural ribs welded to the outer surface
- Panels are craned into place and then clamped to the I-beam flanges from the outside
- The seams are then welded using automated welders where possible
- Ventilation will be needed
- Scissor lifts and arial lifts will be required for access



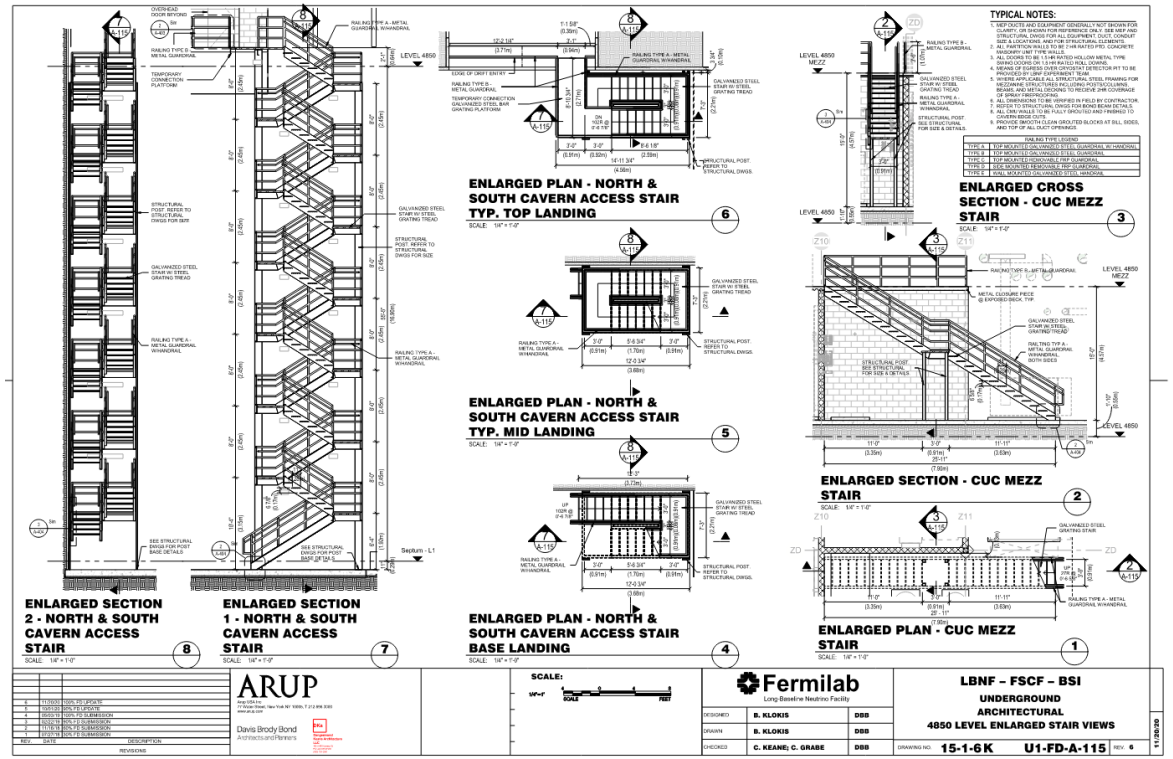
# Layout of W end of cavern

- The cryostat will be constructed in E end of the cavern
- Alimak and temp stairs are provided by Integration
- Permanent stairs provided by FSCF

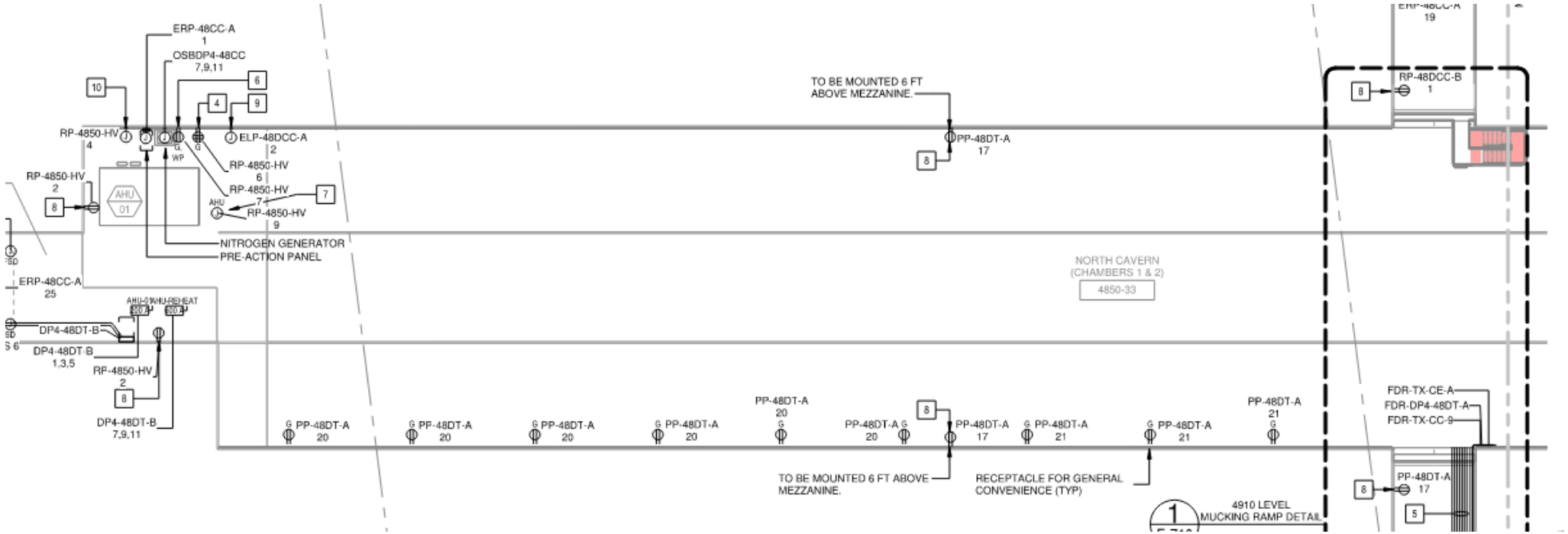


# Stairs provided by FSCF

- This is currently in the BSI scope
- When will these be provided/available?
- When are they needed or do they interfere with warm structure construction?



# Electrical plans W entrance



# W entrance 4850 electrical details

- This panel is 480 3-phase and the cavern AHU will be powered from this.
- Plenty of spares, but this is likely too far away to be useful for cryostat construction
- Temp lighting will be needed at the W entrance
- For all panels discussed, can the final panels be installed and powered by temporary feeds until permanent power is made available?

**PANEL: DP4-48DT-B**

**LOCATION:** NORTH CAVERN WEST ENTRANCE
**SUPPLY FROM:** SWBD4-48CC-A
**MOUNTING:** SURFACE
**ENCLOSURE:** TYPE 3R

**VOLTS:** 480/277 Wye
**PHASE:** 3
**WIRE:** 4

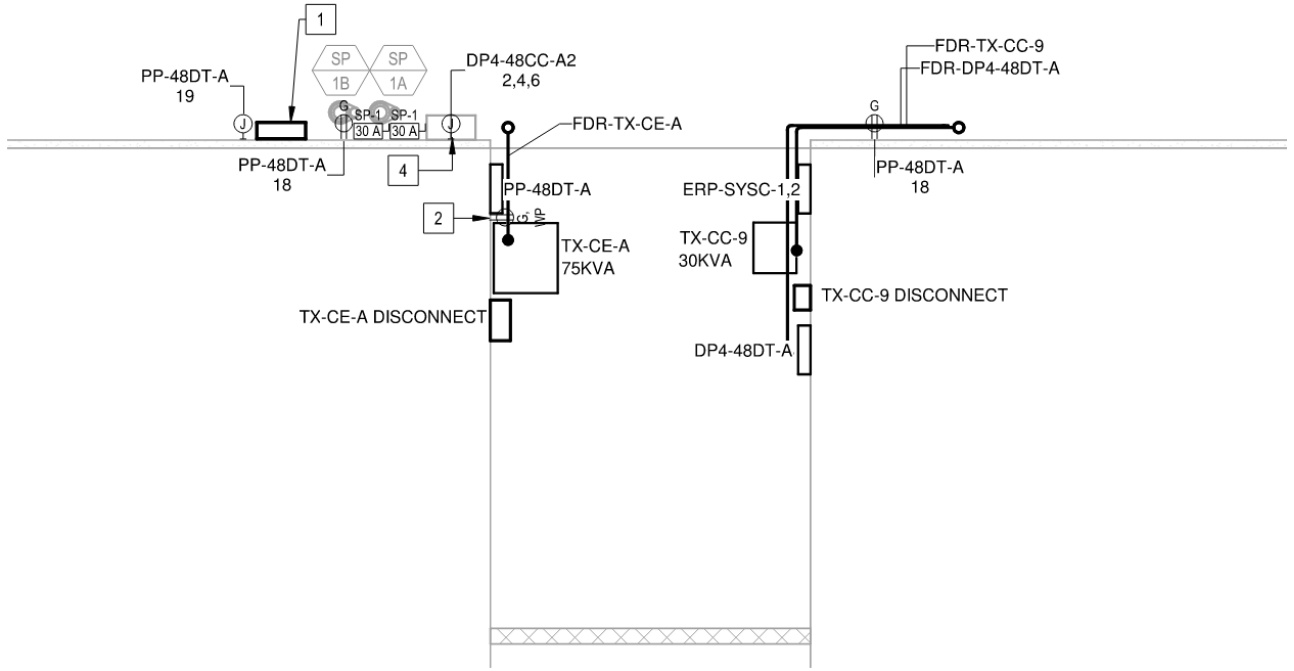
**A.I.C. RATING:** 35kA
**BUS RATING:** 800
**MAIN CB:** 800

| CKT | CIRCUIT DESCRIPTION | TRIP | POLES | A | | B | | C | | POLES | TRIP | CIRCUIT DESCRIPTION | CKT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | AHU-01 | 150 | 3 | 22144 VA | 3833 VA | | | | | 3 | 60 | WELDING OUTLET | 2 |
| 3 | -- | -- | -- | | | 22144 VA | 3833 VA | | | -- | -- | -- | 4 |
| 5 | -- | -- | -- | | | | | 22144 VA | 3833 VA | -- | -- | -- | 6 |
| 7 | AHU-01 RECOIL HEAT | 500 | 3 | 103911... | 3833 VA | | | | | 3 | 60 | WELDING OUTLET | 8 |
| 9 | -- | -- | -- | | | 103911... | 3833 VA | | | -- | -- | -- | 10 |
| 11 | -- | -- | -- | | | | | 103911... | 3833 VA | -- | -- | -- | 12 |
| 13 | WELDING OUTLET | 60 | 3 | 3833 VA | 3833 VA | | | | | 3 | 60 | WELDING OUTLET | 14 |
| 15 | -- | -- | -- | | | 3833 VA | 3833 VA | | | -- | -- | -- | 16 |
| 17 | -- | -- | -- | | | | | 3833 VA | 3833 VA | -- | -- | -- | 18 |
| 19 | WELDING OUTLET | 60 | 3 | 3833 VA | 0 VA | | | | | 1 | 20 | SPARE | 20 |
| 21 | -- | -- | -- | | | 3833 VA | 0 VA | | | 1 | 20 | SPARE | 22 |
| 23 | -- | -- | -- | | | | | 3833 VA | 0 VA | 1 | 20 | SPARE | 24 |
| 25 | SPARE | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SPARE | 26 |
| 27 | SPARE | 20 | 1 | | | 0 VA | 0 VA | | | 1 | 20 | SPARE | 28 |
| 29 | SPARE | 20 | 1 | | | | | 0 VA | 0 VA | 1 | 20 | SPARE | 30 |
| 31 | SPARE | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SPARE | 32 |
| 33 | SPARE | 20 | 1 | | | 0 VA | 0 VA | | | 1 | 20 | SPARE | 34 |
| 35 | SPARE | 20 | 1 | | | | | 0 VA | 0 VA | 1 | 20 | SPARE | 36 |
| 37 | SPARE | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SPARE | 38 |
| 39 | SPARE | 20 | 1 | | | 0 VA | 0 VA | | | 1 | 20 | SPARE | 40 |
| 41 | SPARE | 20 | 1 | | | | | 0 VA | 0 VA | 1 | 20 | SPARE | 42 |
| | | **TOTAL LOAD:** | | 141854 VA | | 141854 VA | | 141854 VA | | | | | |
| | | **TOTAL AMPS:** | | 512 | | 512 | | 512 | | | | | |

**NOTES:**

# Electrical plans at 4910 Alcove

- General question, since we made the alcove deeper, can the panels be moved to the rear to make the usable space closer to the opening?



# 4910 details

- There are two panels here
  - one is 120/208 and feeds all of the convenience outlets and receptacles in the cavern and other BMS items
  - The other is 480 3-phase.  All of the LAr pumps for the two cryostats in the cavern are powered from this panel (the pumps are not powered until the LAr fill begins)
- There is plenty of capacity for welding outlets from this panel

**PANEL: PP-48DT-A**

**LOCATION:** MUCKING RAMP (4910L) **VOLTS:** 120/208 Wye **A.I.C. RATING:** 22kA
**SUPPLY FROM:** TX-CE-A **PHASE:** 3 **BUS RATING:** 225
**MOUNTING:** SURFACE **WIRE:** 4 **MAIN CB:** 225
**ENCLOSURE:** TYPE 3R

| CKT | CIRCUIT DESCRIPTION | TRIP | POLES | A | | B | | C | | POLES | TRIP | CIRCUIT DESCRIPTION | CKT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SP-01 | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SP-02 | 2 |
| 3 | -- | -- | -- | | | 0 VA | 0 VA | | | -- | -- | -- | 4 |
| 5 | -- | -- | -- | | | | | 0 VA | 0 VA | -- | -- | -- | 6 |
| 7 | SP-03 | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SP-04 | 8 |
| 9 | -- | -- | -- | | | 0 VA | 0 VA | | | -- | -- | -- | 10 |
| 11 | -- | -- | -- | | | | | 0 VA | 0 VA | -- | -- | -- | 12 |
| 13 | SP-05 | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SP-06 | 14 |
| 15 | SP-07 | 20 | 1 | | | 0 VA | 0 VA | | | 1 | 20 | SP-08 | 16 |
| 17 | FOR GEOTECH INSTRUMENTATION | 20 | 1 | | | | | 600 VA | 720 VA | 1 | 20 | NORTH LOW. CAVERN CONV. REC. | 18 |
| 19 | BMS PANEL | 20 | 1 | 500 VA | 1080 VA | | | | | 1 | 20 | CONV. RECEPTACLES | 20 |
| 21 | CONV. RECEPTACLES | 20 | 1 | | | 1080 VA | 1080 VA | | | 1 | 20 | CONV. RECEPTACLES | 22 |
| 23 | SPARE | 20 | 1 | | | | | 0 VA | 0 VA | 1 | 20 | SPARE | 24 |
| 25 | SPARE | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SPARE | 26 |
| 27 | SPARE | 20 | 1 | | | 0 VA | 0 VA | | | 1 | 20 | SPARE | 28 |
| 29 | SPARE | 20 | 1 | | | | | 0 VA | 0 VA | 1 | 20 | SPARE | 30 |
| 31 | SPARE | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SPARE | 32 |
| 33 | SPARE | 20 | 1 | | | 0 VA | 0 VA | | | 1 | 20 | SPARE | 34 |
| 35 | SPARE | 20 | 1 | | | | | 0 VA | 0 VA | 1 | 20 | SPARE | 36 |
| 37 | SPARE | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SPARE | 38 |
| 39 | SPARE | 20 | 1 | | | 0 VA | 0 VA | | | 1 | 20 | SPARE | 40 |
| 41 | SPARE | 20 | 1 | | | | | 0 VA | 0 VA | 1 | 20 | SPARE | 42 |
| | | **TOTAL LOAD:** | | 1580 VA | | 2160 VA | | 1320 VA | | | | | |
| | | **TOTAL AMPS:** | | 14 | | 18 | | 11 | | | | | |

**NOTES:**

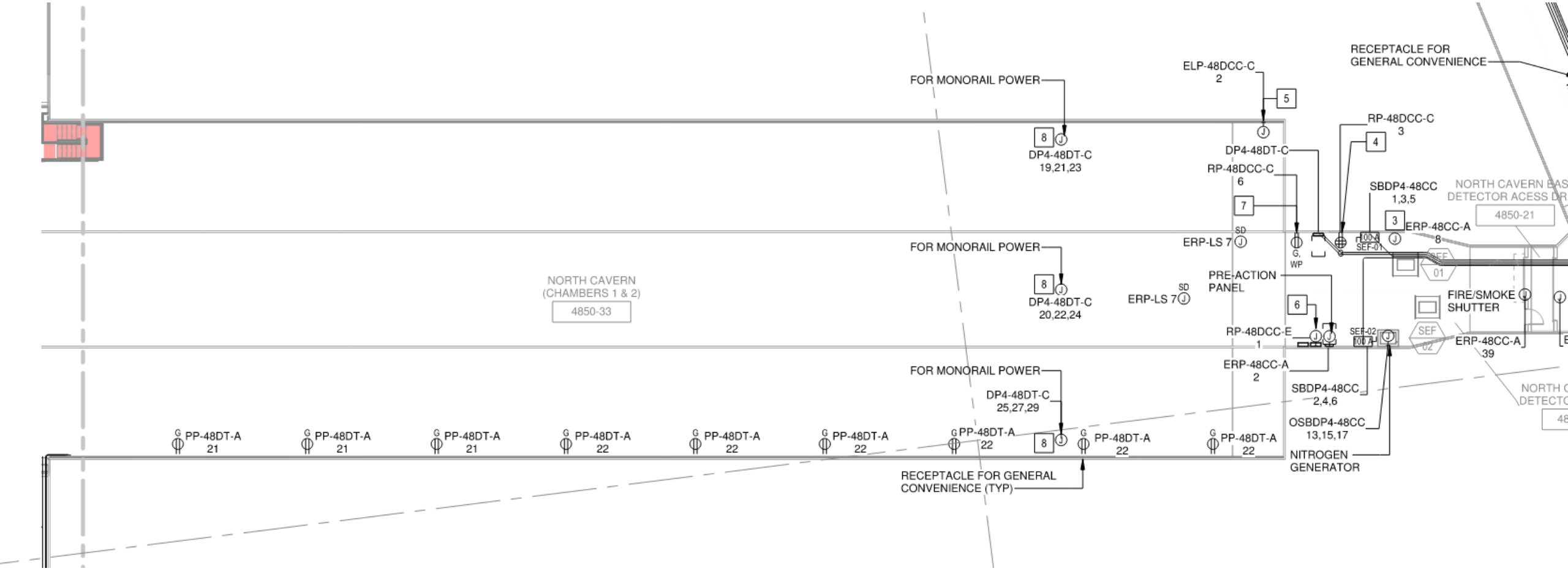
**PANEL: DP4-48DT-A**

**LOCATION:** MUCKING RAMP (4910L) **VOLTS:** 480/277 Wye **A.I.C. RATING:** 35kA
**SUPPLY FROM:** SWBD4-48CC-A **PHASE:** 3 **BUS RATING:** 400
**MOUNTING:** SURFACE **WIRE:** 4 **MAIN CB:** 400
**ENCLOSURE:** TYPE 3R

| CKT | CIRCUIT DESCRIPTION | TRIP | POLES | A | | B | | C | | POLES | TRIP | CIRCUIT DESCRIPTION | CKT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | LIQUID ARGON PUMP 1 | 15 | 3 | 1733 VA | 1733 VA | | | | | 3 | 15 | LIQUID ARGON PUMP 5 | 2 |
| 3 | -- | -- | -- | | | 1733 VA | 1733 VA | | | -- | -- | -- | 4 |
| 5 | -- | -- | -- | | | | | 1733 VA | 1733 VA | -- | -- | -- | 6 |
| 7 | LIQUID ARGON PUMP 2 | 15 | 3 | 1733 VA | 1733 VA | | | | | 3 | 15 | LIQUID ARGON PUMP 6 | 8 |
| 9 | -- | -- | -- | | | 1733 VA | 1733 VA | | | -- | -- | -- | 10 |
| 11 | -- | -- | -- | | | | | 1733 VA | 1733 VA | -- | -- | -- | 12 |
| 13 | LIQUID ARGON PUMP 3 | 15 | 3 | 1733 VA | 1733 VA | | | | | 3 | 15 | LIQUID ARGON PUMP 7 | 14 |
| 15 | -- | -- | -- | | | 1733 VA | 1733 VA | | | -- | -- | -- | 16 |
| 17 | -- | -- | -- | | | | | 1733 VA | 1733 VA | -- | -- | -- | 18 |
| 19 | LIQUID ARGON PUMP 4 | 15 | 3 | 1733 VA | 1733 VA | | | | | 3 | 15 | LIQUID ARGON PUMP 8 | 20 |
| 21 | -- | -- | -- | | | 1733 VA | 1733 VA | | | -- | -- | -- | 22 |
| 23 | -- | -- | -- | | | | | 1733 VA | 1733 VA | -- | -- | -- | 24 |
| 25 | WELDING OUTLET | 60 | 3 | 3833 VA | 3833 VA | | | | | 3 | 60 | WELDING OUTLET | 26 |
| 27 | -- | -- | -- | | | 3833 VA | 3833 VA | | | -- | -- | -- | 28 |
| 29 | -- | -- | -- | | | | | 3833 VA | 3833 VA | -- | -- | -- | 30 |
| 31 | WELDING OUTLET | 60 | 3 | 3833 VA | 3833 VA | | | | | 3 | 60 | WELDING OUTLET | 32 |
| 33 | -- | -- | -- | | | 3833 VA | 3833 VA | | | -- | -- | -- | 34 |
| 35 | -- | -- | -- | | | | | 3833 VA | 3833 VA | -- | -- | -- | 36 |
| 37 | WELDING OUTLET | 60 | 3 | 3833 VA | 3833 VA | | | | | 3 | 60 | WELDING OUTLET | 38 |
| 39 | -- | -- | -- | | | 3833 VA | 3833 VA | | | -- | -- | -- | 40 |
| 41 | -- | -- | -- | | | | | 3833 VA | 3833 VA | -- | -- | -- | 42 |
| | | **TOTAL LOAD:** | | 36862 VA | | 36862 VA | | 36862 VA | | | | | |
| | | **TOTAL AMPS:** | | 133 | | 133 | | 133 | | | | | |

**NOTES:**

# Electrical plans E entrance



# E entrance electrical details

- This panel is 480 3-phase
- It powers the monorail hoists and overhead crane
- There is capacity for welding outlets

- Comment about welding outlets

The cryostat is a very large area and welding of the tertiary membrane will cover the entire inner surface. Think about the cryostat in two halves, upper and lower. Use the E entrance power for the upper half welders and the 4910 alcove for the lower

**PANEL: DP4-48DT-C**

**LOCATION:** NORTH CAVERN EAST ENTRANCE
**SUPPLY FROM:** SWBD4-48CC-A
**MOUNTING:** SURFACE
**ENCLOSURE:** TYPE 3R

**VOLTS:** 480/277 Wye
**PHASE:** 3
**WIRE:** 4

**A.I.C. RATING:** 35kA
**BUS RATING:** 400
**MAIN CB:** 400

| CKT | CIRCUIT DESCRIPTION | TRIP | POLES | A | | B | | C | | POLES | TRIP | CIRCUIT DESCRIPTION | CKT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | WELDING OUTLET | 60 | 3 | 3833 VA | 3833 VA | | | | | 3 | 60 | WELDING OUTLET | 2 |
| 3 | -- | -- | -- | | | 3833 VA | 3833 VA | | | -- | -- | -- | 4 |
| 5 | -- | -- | -- | | | | | 3833 VA | 3833 VA | -- | -- | -- | 6 |
| 7 | WELDING OUTLET | 60 | 3 | 3833 VA | 3833 VA | | | | | 3 | 60 | WELDING OUTLET | 8 |
| 9 | -- | -- | -- | | | 3833 VA | 3833 VA | | | -- | -- | -- | 10 |
| 11 | -- | -- | -- | | | | | 3833 VA | 3833 VA | -- | -- | -- | 12 |
| 13 | WELDING OUTLET | 60 | 3 | 3833 VA | 3833 VA | | | | | 3 | 60 | WELDING OUTLET | 14 |
| 15 | -- | -- | -- | | | 3833 VA | 3833 VA | | | -- | -- | -- | 16 |
| 17 | -- | -- | -- | | | | | 3833 VA | 3833 VA | -- | -- | -- | 18 |
| 19 | MONORAIL CRANE POWER | 90 | 3 | 18435 VA | 17272 VA | | | | | 3 | 80 | MONORAIL CRANE POWER | 20 |
| 21 | -- | -- | -- | | | 18435 VA | 17272 VA | | | -- | -- | -- | 22 |
| 23 | -- | -- | -- | | | | | 18435 VA | 17272 VA | -- | -- | -- | 24 |
| 25 | MONORAIL CRANE POWER | 125 | 3 | 27071 VA | 0 VA | | | | | 1 | 20 | SPARE | 26 |
| 27 | -- | -- | -- | | | 27071 VA | 0 VA | | | 1 | 20 | SPARE | 28 |
| 29 | -- | -- | -- | | | | | 27071 VA | 0 VA | 1 | 20 | SPARE | 30 |
| 31 | SPARE | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SPARE | 32 |
| 33 | SPARE | 20 | 1 | | | 0 VA | 0 VA | | | 1 | 20 | SPARE | 34 |
| 35 | SPARE | 20 | 1 | | | | | 0 VA | 0 VA | 1 | 20 | SPARE | 36 |
| 37 | SPARE | 20 | 1 | 0 VA | 0 VA | | | | | 1 | 20 | SPARE | 38 |
| 39 | SPARE | 20 | 1 | | | 0 VA | 0 VA | | | 1 | 20 | SPARE | 40 |
| 41 | SPARE | 20 | 1 | | | | | 0 VA | 0 VA | 1 | 20 | SPARE | 42 |
| | | **TOTAL LOAD:** | | 85776 VA | | 85776 VA | | 85776 VA | | | | | |
| | | **TOTAL AMPS:** | | 310 | | 310 | | 310 | | | | | |

**NOTES:**

# Logistics

- Equipment at surface to move material into the shaft for both cage and slung loads
- Equipment at 4850 to remove slung loads from the shaft
- Equipment at 4850 to move items from shaft to N cavern

# Other activities

- Grouting of the lower beams
  - May be premixed at the surface
  - IF not, it will require water which could be provided in containers from the surface and some sort of mixer.  Can this use the batch processing plant underground?
- Surveying the beam locations as construction progresses